Clark County NPDES Long-term Index Site Project: Quality Assurance Project Plan

Project Title: Long-term Index Site Project (LISP)
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Client Approval:_____________________________________ Date:_____________
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Clark County NPDES Long-term Index Site Project: Quality Assurance Project Plan

Purpose of the Quality Assurance Project Plan

A quality assurance project plan (QAPP) is required for each project or ongoing program activity. The plan describes the basis for the design, the means by which data is collected and reported, and how the data will meet the needs of the monitoring project. The QAPP sets procedures to be followed by people performing the monitoring activity. In some cases, methods and schedules may be revised as the program evolves.

Clark County Public Works Water Resources (Water Resources) follows the general QAPP format defined by the Washington Department of Ecology (February 2001).

The QAPP does not include detailed descriptions of all field activities. Standard procedures for data collection have been developed by Water Resources and are incorporated by reference in this document. Documentation of standard procedures is available from Water Resources.

Organization and Schedule Summary

Water Resources Staff

Water Resources activities are administered through Clark County Public Works as part of the county's NPDES Stormwater Management Program. **Earl Rowell** is the Water Resources manager. **Rod Swanson**, Senior Planner, coordinates monitoring activities within the NPDES program and between the program and other agencies, directs lead/support staff, and works with staff on project design and implementation. **Jeff Schnabel**, Water Resource Scientist, is the project manager, primarily responsible for project design, implementation, and data analysis. **Ron Wierenga**, Water Resource Scientist, assists with project management activities and serves as the Water Resources QC officer, primarily responsible for standard procedure development and QC compliance. The project manager will oversee field activities and will be responsible for the execution of the monitoring project in accordance with the procedures outlined in this QAPP. **Sam Giese**, Capital Engineer, assists with hydrologic data collection systems and data analysis. Trained and supervised **technicians** assist in field data collection and data entry.

Laboratory Contracts

Laboratory water quality analyses for the project will be performed by North Creek Analytical Laboratories (NCA), a Washington Department of Ecology (Ecology) accredited laboratory located in Beaverton, Oregon. Benthic macroinvertebrate samples will be analyzed by qualified macroinvertebrate identification laboratories. Laboratories may change based on price quotes from qualified labs, or as project needs evolve.

Decision Makers and other Stakeholders

Information gained from the LISP will help to inform policy makers, the general public, and the Washington Department of Ecology about water quality and stream health trends in the index site reaches. The information will be summarized and reported to Ecology as part of the county's NPDES permit compliance annual reports.

Schedule Summary

The most intensive field work for this project will occur during late July to early October in accordance with standard practices for macroinvertebrate sampling and physical habitat assessment. Excessively wet weather or unexpected logistical problems could force parts of the sampling regimen to be eliminated in any given year. Priority will be given to the macroinvertebrate sampling over physical habitat assessment. Estimated project timelines for year one and subsequent years are outlined below.

The LISP is a long-term trend monitoring project. As such, it will take a period of years to develop a dataset sufficient for describing trends in stream health. Though annual reports should provide useful characterization information, the overall objectives of the project cannot be met in a short-term time frame.

Year One Project Timeline:

Preliminary site survey:	February-March 2001
Equipment purchase:	April-May 2001
Field testing/staff training:	May-June 2001
Site selection:	May-June 2001
Year one benthic macroinvertebrate sampling:	August-October 2001
Year one quantitative habitat assessment:	August-October 2001
Year one qualitative habitat assessment:	July 2001- October 2001
Hydrologic monitoring:	October 2001- ongoing
Water quality monitoring:	October 2001- ongoing (monthly)
Data entry into project spread sheets	As collected
Year one summary report:	Submitted with Annual NPDES Report

Subsequent Yearly Project Timeline:

Water quality monitoring:	ongoing (monthly)
Equipment updates:	April-May
Field testing/staff training:	May-June
Benthic macroinvertebrate sampling:	July-October
Quantitative habitat assessment:	July-October
Qualitative habitat assessment:	July-October
Hydrologic monitoring:	Ongoing
Data entered into project spreadsheets	Ongoing
Data entered into central database	Beginning spring 2003 (projected)
Project audit	May
Annual summary report:	June with annual NPDES report

Budget

The budget estimate for startup and completing Year One of the LISP is approximately $100,000 and is included in Appendix A. Subsequent years will be less costly as the project becomes a routine activity. Complete cost tracking is not possible because there is not a separate work order for the LISP. The entire program budget is derived from stormwater fees under fund 4420.

Background and Problem Statement

Historical and Technical Basis

The LISP fills a need for a project to observe and describe changes in stream health. It is designed to satisfy requirements of the county's 1999 NPDES municipal stormwater permit conditions S5.B.4. and S9.C.5. to describe watershed conditions, evaluate overall program effectiveness, and assess the degree to which stormwater influences water bodies. The LISP is also intended to help meet expected requirements under future permits to analyze long-term trends in water body condition.

In addition to mandated NPDES requirements, the Board of Clark County Commissioners (BOCC) and the county's Clean Water Commission (CWC) have made clear statements requesting scientifically defensible information about stream health status and trends. Long-term monitoring will provide a basis for determining whether overall policy approaches for improving water body health are achieving measurable results.

A growing body of scientific literature (NMFS, August 1996; US EPA, July 1999; Center for Watershed Protection, 1998; and Idaho Department of Environmental Quality, 1999), recommends the use of "indicators" to monitor and track changes in stream condition. Indicators are measurable parameters, or groups of parameters, which describe stream health. They fall into several major categories, including biological parameters, physical habitat, physicochemical water quality, hydrology, and land use. The LISP utilizes selected indicator parameters from each of these categories, with the intent of identifying long term trends at a set of index sites typical of Clark County waterbodies.

Problem Statement

Stormwater-influenced or dominated streams can act as an integrated indicator of human-caused changes to waterbody health. There is little historical information describing the condition of these smaller, stormwater runoff-conveying streams in Clark County. Many of these streams have been impacted by human activities and exhibit water quality degradation, hydrologic changes, and habitat alterations, but few data exist to systematically document current conditions or trends in stream condition. The LISP will address this information gap by providing information describing trends in stream condition at a number of sites in the county.

Project Description

Goal

The primary goal of the Long-term Index Site Project is to identify trends in stream health at a set of stormwater-influenced and stormwater-dominated streams by monitoring a set of stream health indicators.

Objectives

General objectives are to:

- Collect data that are representative of actual stream conditions and comparable to data collected by other local and regional agencies
- Provide Clark County decision-makers with scientifically defensible information about long-term trends in receiving-water condition at selected sites
- Assess the level of beneficial use attainment at selected sites
- Periodically refine the set of indicators based on the current state of monitoring science and the long-term usefulness of the data generated
- Attempt to discern relationships between various stream health indicators (e.g. between water quality parameters and benthic macroinvertebrate populations)

Specific indicator group objectives are:

1) Describe current stream health and trends over time using biological indicators.

   Benthic macroinvertebrate samples will be collected following the procedures described in Ecology's Instream Biological Assessment Monitoring Protocols: Benthic Macroinvertebrates (Plotnikoff, 2001). Standard procedures are described in the county's Standard Procedures for Monitoring Activities: Clark County Water Resources Section (2002). Results will be used to compute the necessary metrics for calculating the Benthic Invertebrate Index of Biological Integrity (B-IBI) (Karr, 1998; Karr and Chu, 1999), or other metrics and indices as needed or as prescribed by Ecology.

   Metric and index scores will be used primarily to characterize current conditions and analyze trends at individual sites.

2) Describe current stream health and trends over time using qualitative and quantitative physical habitat indicators.

   Qualitative assessments will be made using EPAs Rapid Bioassessment Protocols for Use in Streams and Wadable Rivers: Habitat Assessment and Physicochemical Parameters (1999). Standard procedures are described in the county's Standard Procedures for Monitoring Activities: Clark County Water Resources Section (2002). Scores will be used to characterize current conditions and compare each site to a theoretical high-quality reference condition. Secondary objectives may include assessing the overall variability and reliability of the qualitative assessments by comparing results to the more rigorous quantitative assessments.

   Quantitative assessments will be made using the physical habitat characterization method of the Environmental Monitoring and Assessment Program (EMAP) developed by the US

Environmental Protection Agency (EPA). Standard procedures are described in the county's Standard Procedures for Monitoring Activities: Clark County Water Resources Section (2002). A variety of metrics ranging from stream substrate to canopy cover will be calculated.

Results for each metric will be compared over time to assess changes at individual sites.

3) Describe current stream health and trends over time using selected water quality indicators.

A suite of water quality indicators will be monitored to allow calculation of the Oregon Water Quality Index (OWQI). OWQI parameters include temperature, dissolved oxygen, pH, ammonia, nitrate + nitrite, total phosphorus, total solids, and fecal coliform bacteria. Biochemical oxygen demand (BOD) is also included in the OWQI, but will not be analyzed in this project. Samples will also be collected for conductivity, turbidity, and E.coli bacteria. Standard procedures are described in the county's Standard Procedures for Monitoring Activities: Clark County Water Resources Section (2002).

In addition to instantaneous grab samples, in-situ data loggers will be deployed to provide continuous temperature data during summer. Data will be used primarily to assess long-term trends and compare to water quality criteria. Data loggers may also be deployed to compare differing stream habitats such as pools and riffles. Additional detailed studies of individual stream reaches may be considered after the program is underway.

Bacteria samples are collected as a pathogen indicator. In addition to being a useful indicator of human health risk, bacteria indicators are also regulated under state water quality standards. Specific bacterial indicators may change over the course of the project in response to changes in state standards, but will generally include fecal coliform and/or E.coli.

Diurnal investigations of dissolved oxygen concentration may be conducted at each site at some time during the project. Diurnal investigations will occur during late summer when dissolved oxygen minima are most likely to occur.

4) Measure hydrologic indicators to characterize stream hydrology and changes over time.

Instantaneous discharge measurements will be collected in the process of developing discharge rating curves for each of the LISP sites. Standard procedures are described in the county's Standard Procedures for Monitoring Activities: Clark County Water Resources Section (2002). Continuous stage recorders will be installed at the Curtin, Mill, Jones, Breeze, and Whipple sites during year 2 or 3. Discharge data will be used to calculate metrics such as TQ_{mean}, base flow rates, and minimum and maximum flows.

Instantaneous discharge measurements will also be collected as part of the EMAP physical habitat characterization. During the first year of operation, each site will be fitted with a staff gauge or a fixed point from which to measure stream stage when monthly water quality grab samples are collected.

Peak stage and flood frequency will be monitored for sites where either crest gages or continuous stage recording equipment are present. Depending on need, more intensive data collection may occur at some sites for use in planning capital projects.

5) Use land use indicators such as road density to describe current conditions and analyze changes over time.

   Data from the LISP will be used to help relate land-use indicators to observed stream health.

   Geographic Information System (GIS) analyses will be used to define current conditions and document changes in the status of some or all of the following indicators: estimated percent total impervious area (TIA), zoning, road density, channel density (stream, ditch and pipe miles per square mile), road crossings, stormwater outfalls/stream mile, percent forest cover, percent wetland cover, percent riparian forest >100 ft, and percent riparian forest <30 ft. Some GIS stormwater indicators will be evaluated countywide in other NPDES program and Endangered Species Act Program projects.

Sampling Design

Site Selection

Approximately 100 stream sites, predominantly located at road crossings or on public lands, were field checked and catalogued as potential monitoring locations during January and February 2001. LISP sites were selected from among these sites based primarily on long-term accessibility. Subwatershed geology, stream gradient, and drainage area land use were also considered in an attempt to include a representative cross-section of county streams. Specifying perpetual accessibility to a stream reach as a primary selection criteria led to picking stream reaches on public lands where easements or other costly arrangements would not be required to secure long-term access.

Sites are located on lands owned by school districts, Vancouver/Clark Parks, Clark County Public Works, the State of Washington Department of Natural Resources (DNR), and the City of Camas. One reach is located on private land. In most cases, access was secured through a Memorandum of Understanding (MOU) between Clark County and each land-owning entity. The need for a stream reach of 40 times the wetted stream width (minimum 500 feet) greatly limited the possible number of sites on public lands. Figure 1 shows the location of the ten LISP sites.

The site selection process was intended to identify a set of sites that could be assessed individually over time and, possibly, as a group to make a qualified statement about overall stream health condition and trends in Clark County. Information gained from the design and protocols described in this QAPP is technically applicable only to the specific sites being monitored. Valid comparisons may be drawn between the sampled sites, but comparisons between sampled sites and un-sampled areas is limited because the LISP sites do not comprise a random sample of all available sites. Therefore, attempts to extrapolate results county-wide or to infer conditions at un-sampled areas will generally be qualitative in nature. In future years, the sampling design may be altered to address this issue.

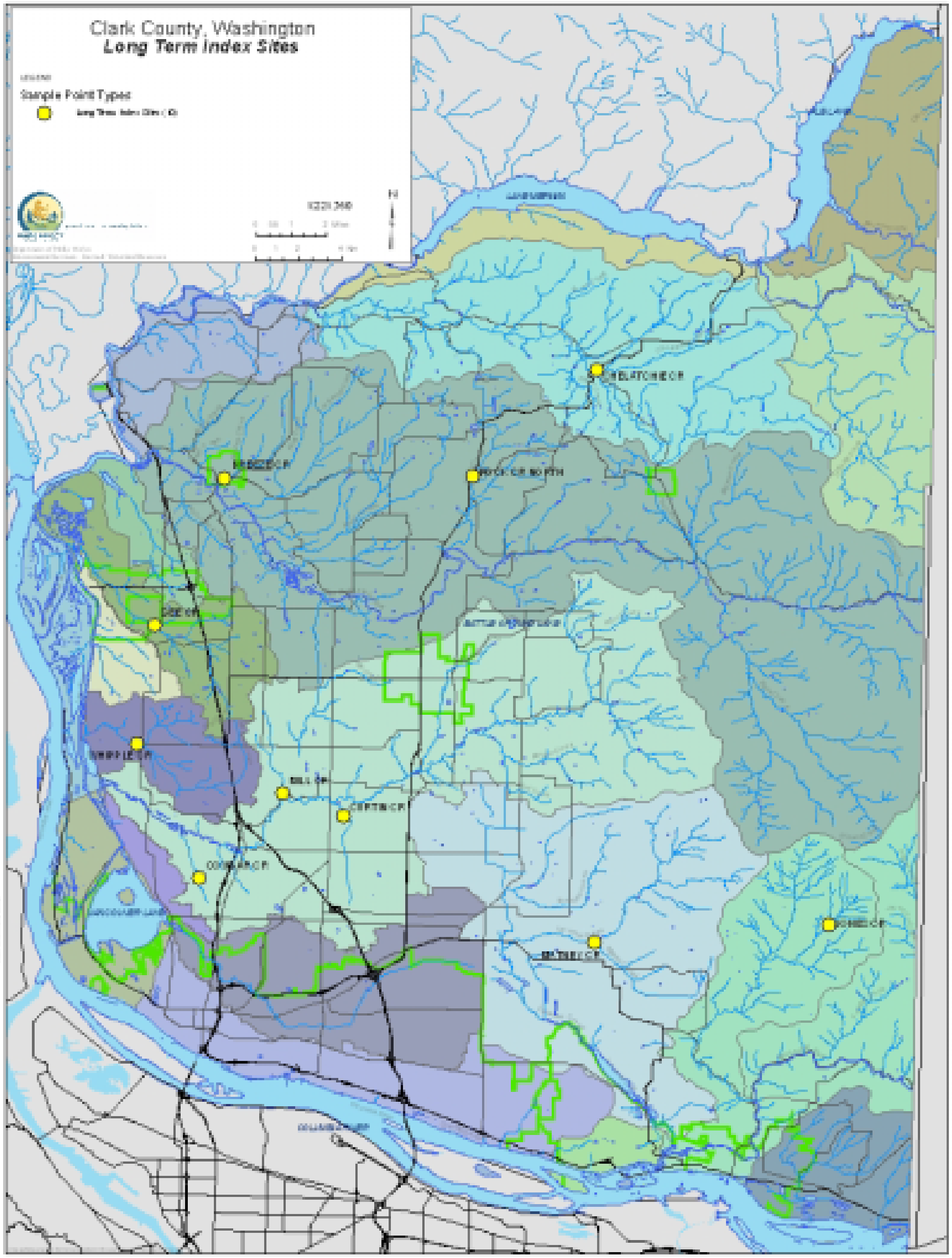

Figure 1. Location of the ten LISP monitoring sites.

Monitoring Schedule

Monitoring will begin in summer 2001 and will continue indefinitely, until the project is discontinued or altered. Sampling intervals may be different for various indicators.

Benthic macroinvertebrate monitoring, visual habitat surveys, and quantitative habitat assessments will be performed during the summer low-flow period (July- September). Habitat assessments require in-stream work and coordination with benthic macroinvertebrate sampling, so a summer low-flow sampling schedule is optimal. Consistent use of summer and early fall sampling dates will ensure consistency in the seasonal condition of habitat parameters.

Temperature readings will be recorded continuously at 1-hour intervals from approximately June-October using in-situ data loggers. Samples for all other physicochemical water quality parameters will be collected during monthly grab sampling events. Instantaneous discharge measurements will be collected as necessary to build rating curves. Stage recording equipment will be serviced and maintained monthly or as necessary.

Table 1 summarizes the parameter/indicators, sampling schedules, and sample types used in the LISP.

Parameter or Indicator	Schedule	Sample Type
Benthic macroinvertebrates	August-September	composite
EPA rapid habitat	August-September	visual survey
EPA EMAP habitat	August-September	quantitative survey
Temperature	1) continuous- summer 2) monthly	1) in-situ logger 2) field meter
Dissolved oxygen	monthly	field meter
pH	monthly	field meter
Conductivity	monthly	field meter
Turbidity	monthly	field meter/grab
Total solids	monthly	grab
Ammonia	monthly	grab
Nitrate + nitrite	monthly	grab
Total phosphorus	monthly	grab
Fecal coliform/E.coli	monthly	grab
Discharge	1)continuous 2) instantaneous	1) in-situ logger 2) field meter

Table 1. Indicators, schedule, and sample type.

Representativeness

A result is “representative” of the sampled population when it accurately reflects the actual characteristics of that population. The LISP is designed to collect representative data about stream conditions at the time of sampling, and there are no known constraints that would adversely affect the representativeness of the samples from each site.

Sampling protocols are designed to facilitate the collection of representative samples. For example, effective benthic macroinvertebrate collection requires that potential riffle sampling sites not be disrupted during field reconnaissance and that other measurements such as habitat or discharge be made after the macroinvertebrate sample is collected. Macroinvertebrate sampling is also conducted from downstream to upstream in order to avoid contamination of downstream samples.

The sample sites themselves were chosen to represent a cross-section of water body types within Clark County, but are not statistically "representative" of Clark County water bodies as a whole.

Data Comparability

One of the objectives of the LISP is to gather data that are comparable to other local and regional data. Long-term comparability of LISP data to other data is facilitated by specifying standard procedures for data collection and analyses.

Data collected under the LISP will be compared between project sites and between years. Physicochemical data will be examined in light of applicable state standards and criteria. Physicochemical data will also be analyzed using the Oregon Water Quality Index (OWQI), which will allow comparison of project sites to other areas in the Willamette Valley ecoregion. Benthic macroinvertebrate data will likely be pooled with other data in regional analyses by state or federal agencies.

Coordination

The monitoring coordinator and other project staff will work to coordinate LISP activities with other monitoring efforts in Clark County. Specifically, the program will seek to coordinate with Clark County Endangered Species Act Program monitoring projects, Clark Public Utilities Salmon Creek monitoring, and other local monitoring efforts to ensure comparability of methods and to minimize overlap of monitoring sites.

Data Quality Objectives, Field and Laboratory Procedures

Data Quality Objectives

Analytical methods and detection or precision limits for field water quality measurements and laboratory analyses are listed in Table 2. The water quality laboratory's data quality objectives and quality control procedures are detailed in its Ecology-approved QA documents.

Collection, preservation, transportation, and storage of samples will follow standardized procedures to reduce most sources of sampling bias. Analytical bias will be minimized by adherence to the methods listed in Table 2. The laboratory will use quality control procedures appropriate to the analytical procedures, including analysis of method blanks, matrix spikes, and check standards as necessary.

The total precision for water quality field replicate measurements and for the results from duplicate samples (with the exception of bacteria analysis) should not exceed 20% relative percent difference (%RPD) for results at or above the reporting limit. For bacterial results precision up to 50% RPD is acceptable. At levels close to the method detection limit, % RPDs will be greater than 50%, which is to be expected and will be acceptable. In general, pooled results will be evaluated, with the higher %RPDs of low values taken into account. Data variability will be taken into consideration in using the data for modeling and other analysis, and interpreting results.

Expected precision for EMAP habitat assessment protocols varies by parameter. EMAP precision is addressed in the Standard Procedures for Monitoring Activities: Clark County Water Resources Section (2002), and in the EMAP protocol documentation (Kaufmann, et al., 1999).

Repeating qualitative measurements, such as the EPA Rapid Habitat Assessment, over a number of years should provide a basis for estimating their precision, variability, and potential sources of error.

Parameter or Indicator	Method	Reporting Limit/ Resolution	Accuracy	Reference
		conc./ units	field meters only	lab only
Benthic macroinvert. (taxa richness)	4-riffle composite	n/a		
EPA rapid habitat	Visual survey	n/a		
EPA EMAP habitat	Quantitative measures	n/a		
Temperature (grab)	Thermistor	0.01 C	± 0.10°C	
Dissolved oxygen	Membrane electrode	0.01 mg/L	± 0.2 mg/l	
pH	Glass electrode	0.01 units	± 0.2 pH units	
Conductivity	Electrode	4 digits	± 1% of reading	
Turbidity (field) (lab)	Nephelometric Nephelometric	0.01 NTU 0.20 NTU	± 2% of reading	 EPA 180.1
Total solids	Total residue	10.0 mg/L		EPA 160.3
Ammonia	Colorimetric	0.05 mg/L		EPA 350.1
Nitrate + nitrite	Colorometric/Cadmium	0.01 mg/L		EPA 353.2
Total phosphorus	Colorometric	0.02 mg/L		EPA 365.1
Fecal coliform E.coli	Most Probable Number Most Probable Number	2 MPN/100 mL 1 MPN/100 mL		*SM 9221 *SM 9223 B
Stream velocity		0.01 ft/sec	varies w/ veloc.	
*Guidelines Establishing Test Procedures for the Analysis of Pollutants; Analytical Methods for Biological Pollutants in Ambient Water; Proposed Rule				

Table 2. LISP analytical methods and detection or precision limits.

Field Procedures

All sampling, analyses, and data management procedures will be conducted according to guidelines established or referenced in this QAPP, Standard Methods (APHA, 1992), and the contracts between Clark County and the laboratory facilities.

Equipment calibrations, quality assurance, and field data collection protocols for all data collected by the LISP are described in the county's Standard Procedures for Monitoring Activities: Clark County Water Resources Section (2002). All field activities will be conducted by 2-4 person field crews. Sample containers for laboratory delivery will be labeled in indelible ink with the following information:

- Clark County
- LISP
- Site Name
- Parameter(s)
- Date
- Time

Water quality samples will be collected in properly preserved bottles prepared by the laboratory, and stored on ice or in the refrigerator until delivery to NCA. Water quality samples will be picked up by laboratory personnel or shipped within 24 hours of collection. Formal Chain of Custody documentation will be maintained for all samples sent to NCA.

Benthic macroinvertebrate samples will be collected in 1-L polyethylene bottles preserved according to laboratory specifications, and refrigerated until delivery to the contracted benthic macroinvertebrate laboratory for analysis.

Logs will be kept of all field activities. Logs may consist of standardized field sheets as well as bound log books containing ancillary data and observations. Logs will be waterproof and entries made with pencil or indelible ink. All entries will be initialed and dated. Corrections may be made by drawing a single line through the error such that it remains legible, writing the correction adjacent to the error, and initialing the correction. Log entries may include the following, as appropriate:

- Project name and site number
- Identity of field personnel
- Changes in plan
- Antecedent conditions
- Number of samples collected
- Date, time, and description of samples
- Field measurement results
- QC sample identification
- Unusual circumstances affecting data interpretation

Records will be cross-checked for consistency between labels, custody documents, data sheets, field logs, and other relevant data. Documentation will be archived in WR files.

Field equipment will be inspected and maintained by WR staff. Instruments will be calibrated according to manufacturer's instructions prior to each field trip or deployment. LISP field measurement parameters, methods, accuracy, and resolution are found in Table 2.

Laboratory Procedures

Water quality samples will be transported to NCA by laboratory personnel, or properly preserved, packed and shipped to the laboratory for analysis within 24 hours after collection. Standard Chain of Custody procedures will be followed.

Ammonia, nitrate + nitrite, total phosphorus, total solids, and bacteria analyses will be conducted by the laboratory. Turbidity samples may be analyzed either in the field or by the laboratory. All procedures will be performed according to the laboratory's Ecology-approved quality assurance program and according to accepted conventions for data manipulation and reporting as described in Standard Methods (APHA, 1992). Table 2 shows the constituents measured, analytical methods, and reporting limits.

Analytical results will be provided within three weeks of receipt of the samples. Data will be reported as digital Excel worksheet files and backed up with mailed hard copies.

Benthic macroinvertebrate samples will be preserved immediately after collection and shipped to a qualified benthic macroinvertebrate laboratory at the conclusion of the field season. Laboratory analyses will be performed in accordance with Ecology-approved methods for standard taxonomic identifications and metrics.

Quality Control

Laboratory QC

Check standards, matrix spikes, analytical duplicates, and blanks will be analyzed in accordance with the NCA Quality Assurance Program. All QC results will be reported to Water Resources staff along with sample data. Laboratory data reduction, review, and reporting will be performed according to the NCA Quality Assurance Program.

Data will be assessed for precision, accuracy, and completeness according to the methods described in the NCA Quality Assurance Program.

QC for laboratory analysis of benthic macroinvertebrate samples will be performed according to Ecology-recommended procedures (2001).

Field QC

Field QC sample types, frequencies, and definitions for LISP *monthly water quality samples* are found in Table 5. A detailed QC sample schedule is on file in WR and is posted in the field prep area for reference when planning bottle lists. Total variation for field sampling and laboratory analysis of bacteria samples will be assessed by collecting duplicates for approximately 20% of samples. A standard 10% duplication rate will be used for other water quality parameters.

All meters will be pre-calibrated in accordance with the manufacturer's instructions. Checks with standards will evaluate field measurement accuracy for pH and dissolved oxygen. Ten percent of all dissolved oxygen measurements will be checked using a modified Winkler titration. Field blanks will be collected quarterly, and a trip blank will be analyzed once per year. Paired turbidity samples will be collected twice per year to compare field meter results with laboratory measurements. Approximately five percent of all velocity measurements and five percent of all stream discharge profiles will be repeated to determine precision.

Three, 4-replicate benthic macroinvertebrate samples will be collected at 10% of county benthic macroinvertebrate sampling sites (including LISP and other projects) per year. The coefficient of variation among the replicates will be determined for the B-IBI and the taxa richness metric.

Field QC sample type	Frequency	Definition

Field replicate	10% of samples	repeat field measurements
Sample duplicate (bacteria) (all other wq params)	 20% of samples 10% of samples	duplicate sample collected for lab analysis
Field blank	1 per 3 trips	D.I. water sample collected in field w/ sampling equipment
Trip blank	1 per 12 trips	D.I. water sample collected in office and carried through field trip
Paired lab sample	1 per 6 trips	turbidity sample analyzed with field meter, and second sample submitted for lab analysis
Field check DO and pH	1 per 2 trips or 10% of samples	field calibration check for DO (Winkler) and pH (7.0 buffer)
Velocity replicate	5% of meas.	repeat stream velocity measurement
Discharge replicate	5% of meas.	repeat stream discharge profile

Table 5. LISP QC sample types, frequencies, and definitions.

Corrective Actions

Data quality problems discovered through the collection of QC samples will be addressed as needed through re-calibration, modifications to the field procedures, increased staff training, or by qualifying results appropriately. Documentation of corrective action steps will include problem identification, investigation procedures, corrective action taken, and effectiveness of the corrective action.

Data Management Procedures

Data management procedures for the LISP will be revised as the project matures and as Water Resources pursues the development of a centralized data storage and retrieval system.

In the interim, data management procedures for the LISP will be as follows:

Digital data files will be stored on Water Resources' Q: drive (ntcl01/swwg) under Q:\Monitoring\Data\Lisp. Hard copy files will be stored in project-specific binders. Digital files may be backed up on CD on an annual basis. Manually entered data will be cross-checked by the project manager and/or QC officer for accuracy. Data analyses and graphics will generally be produced using Microsoft Excel®. QC data will be stored on Water Resources' Q: drive (ntcl01/swwg) under Q:\Monitoring\Data\Quality control data. The QC officer and project manager will be responsible for validating and cross-checking data entry.

Objective 1: Benthic macroinvertebrate data will be reported by the laboratory in both hard copy and digital formats.

Objective 2: *Rapid Bioassessment Protocol* field data sheets for habitat will be stored in hard copy form only. Final scores will be entered into Excel® worksheets.

EMAP physical habitat characterization data will be stored in hard copy form and also entered into Excel® or other appropriate software formats for the calculation of habitat metrics.

Objective 3: Temperature data from continuous loggers will be downloaded, summarized, and stored in digital format only, as will field measurements such as data collected with portable field meters. Field measurements will be entered manually. Laboratory data will be reported by NCA in both digital and hard copy formats. The laboratory data package will include QC results and an explanation of any necessary data qualifiers.

Objective 4: Hydrologic measurements such as stage and instantaneous discharge measurements will be stored in a separate Excel database. Once stage-discharge rating curves are established and continuous stage recorders are established, stream stage records will also be collected and stored digitally.

Objective 5: Land-use data is stored in the county's Assessment and GIS Department system. Some of these layers, such as roads and tax lots are actively maintained by Assessment and GIS.

Audits and Reports

Audits

The project manager and QC officer will periodically review the field data, methods, lab results, and data management activities to make an assessment of the program and identify corrective actions or method revisions.

Reports

End-of-year reports will address project methods, discuss results by indicator and by site, summarize project findings, describe any significant data quality problems, and suggest modifications for future monitoring. Peer review will be conducted by WR section staff.

During the initial implementation, discussion will focus on characterizing baseline conditions at the LISP sites. As sufficient data are accumulated, the report focus will shift to describing possible trends in stream health.

LISP reports will generally be incorporated as an attachment to the county's annual NPDES permit compliance report to Ecology. Results will also be presented annually to the CWC and BOCC.

Executive summaries, and full reports as warranted, will be placed on the county's website to facilitate dissemination of information to the public.

Data Review, Verification, and Validation

Field data review will be accomplished by the field crew on each sampling trip. Data collected will be cross-checked with the QC sampling schedule to ensure that all appropriate measurements are collected.

Laboratory data will be reviewed for errors and omissions by the project manager. The QC officer will then perform data verification procedures, including examination of QC results for compliance with acceptance criteria. Data validation consists of a detailed examination of the entire data package using professional judgement to assess whether the procedures in the SP's and QAPP have been followed. Data validation will be performed by the project manager and QC officer.

Control charts will be created at the end of each sampling year to determine whether the project Data Quality Objectives have been met for county-collected data. Control charts will be included in year-end reports.

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APPENDICES

Year One Long-term Monitoring Program Cost Estimate

Pre-Planning						
Task	**Component**	**#**	**Units**	**Rate**	**Cost**	**Assumptions**
Number of Sites	**0**					
Start-up	Equipment:	0	set	$0	$0	
	Order/Admin	7	staff days	$250	$1,750	
	Planning:					
	Meetings/Coord	25	staff days	$250	$6,250	*Pro staff 250/day*
	QA plan dev.	10	staff days	$250	$2,500	
	Site selection	10	staff days	$250	$2,500	
	Training	0	staff days	$250	$0	
Field Work/ Mobilization	Vehicle:	0	sites	$7	$0	*$0.34/mile and 20 mi/site*
	Staff time:	0	sites	$250	$0	*2 staff/site and 0.5 day/site*
Laboratory	Analysis:	0	sites	$150	$0	
Data Management	*Data entry*	0	sites	$125	$0	*0.5 staff day/site*
Analysis/Report	Analysis:	0	staff days	$250	$0	
	Reporting:	0	staff days	$250	$0	
			Total		**$13,000**	
			25% contingency		$3,250	
			Grand Total		**$16,250**	

Year One Long-term Monitoring Program Cost Estimate

Benthic Macroinvertebrates						
Task	**Component**	**#**	**Units**	**Rate**	**Cost**	**Assumptions**
Number of Sites	***10***					
Start-up	Equipment:	1	set	$500	$500	
	Planning:					
	Site selection	0	staff days	$250	$0	*Pro staff 250/day*
	Training	10	staff days	$250	$2,500	
Field Work/ Mobilization	Vehicle:	10	sites	$7	$68	*$0.34/mile and 20 mi/site*
	Staff time:	10	sites	$250	$2,500	*2 staff/site and 0.5 day/site*
Laboratory	Analysis:	10	sites	$150	$1,500	
Data Management	*Data entry*	10	sites	$125	$1,250	*0.5 staff day/site*
Analysis/Report	Analysis:	5	staff days	$250	$1,250	*initial analysis development*
	Reporting:	5	staff days	$250	$1,250	
			Total		**$10,818**	
			25% contingency		$2,705	
			Grand Total		**$13,523**	

Year One Long-term Monitoring Program Cost Estimate

Quantitative Habitat Assessment						
Task	**Component**	**#**	**Units**	**Rate**	**Cost**	**Assumptions**
Number of Sites	**10**					
Start-up	Equipment:	1	sets	$800	$800	
	Planning:					
	Site selection	0	staff days	$250	$0	*Pro staff 250/day*
	Training	15	staff days	$250	$3,750	
Field Work/ Mobilization	Vehicle*:	0	sites	$7	$0	*$0.34/mile and 20 mi/site*
	Staff time*:	0	sites	$250	$0	*2 staff/site and 0.5 day/site*
Laboratory	Analysis:	0	sites	$150	$0	
Data Management	Data entry	10	sites	$250	$2,500	*1 staff day/site*
Analysis/Report	Analysis:	5	staff days	$250	$1,250	
	Reporting:	5	staff days	$250	$1,250	

Total	**$9,550**
25% contingency	$2,388
Grand Total	**$11,938**

***NOTE:** Vehicle and staff time for field work are included in the cost estimate for benthic invert. monitoring. Benthic and quantitative H.A. work will occur simultaneously. Conducted independently, a vehicle cost of $7/site visit and a staff cost of $250/site visit would be assigned for each quant. H.A. site.

Year One Long-term Monitoring Program Cost Estimate

Qualitative Habitat Assessment						
Task	**Component**	**#**	**Units**	**Rate**	**Cost**	**Assumptions**
Number of Sites	**10**					
Start-up	Equipment:	1	sets	$250	$250	
	Planning:					
	Site selection	0	staff days	$250	$0	*Pro staff 250/day*
	Training	15	staff days	$250	$3,750	
Field Work/ Mobilization	Vehicle:	10	sites	$7	$68	*$0.34/mile and 20 mi/site*
	Staff time:	10	sites	$250	$2,500	*2 staff/site and 0.5 day/site*
Laboratory	Analysis:	0	sites	$150	$0	
Data Management	*Data entry*	10	sites	$65	$650	*.25 staff day/site*
Analysis/Report	Analysis:	5	staff days	$250	$1,250	
	Reporting:	5	staff days	$250	$1,250	

Total	**$9,718**
25% contingency	$2,430
Grand Total	**$12,148**

NOTE: Qualitative habitat analysis will occur at the same sites **but likely on different visits** as benthic macroinvertebrate monitoring and quantitative H.A.. Therefore, vehicle costs and field time are in addition to that required for the other components.

Year One Long-term Monitoring Program Cost Estimate

Water Quality Assessment						
Task	**Component**	**#**	**Units**	**Rate**	**Cost**	**Assumptions**
Number of Sites:	**10**					
Start-up	Equipment:					
	Purchase	10	sets	$200	$2,000	*includes temp probe only*
	Installation	10	sites	$250	$2,500	*1 staff day/site (includes site prep)*
	Planning:					
	Site selection	0	staff days	$250	$0	*Pro staff 250/day*
	Training	5	staff days	$250	$1,250	
Field Work/ Mobilization	Vehicle:	120 (12 x no. of sites)	site visits	$3	$408	*$0.34/mile and 10 mi/site*
	Staff time:	120 (12 x no. of sites)	site visits	$100	$12,000	*2 staff/site and 0.20 day/site*
Laboratory	Analysis:	120 (12 x no. of sites)	samples	$35	$4,200	*turbidity @ $10* bacteria @ $25
Data Management	Data entry	10	sites	$125	$1,250	*0.5 staff day/site*
Analysis/Report	Analysis:	5	staff days	$250	$1,250	
	Reporting:	5	staff days	$250	$1,250	

Total	**$26,108**
25% contingency	$6,527
Grand Total	**$32,635**

NOTE: Based on monthly visits, laboratory analysis of monthly turbidity samples, use of Hobo-type temperature loggers, and Hydrolab measurements. Additional analyses require increased lab costs.

Year One Long-term Monitoring Program Cost Estimate

Hydrology						
Task	**Component**	**#**	**Units**	**Rate**	**Cost**	**Assumptions**
Number of Sites:	**10**					
Start-up	Equipment:					
	Purchase	10	sets	$250	$2,500	*incl. crest* ***or*** *staff gage*
	*Installation***	10	sites	$500	$5,000	*2 staff day/site (includes site prep)*
	Planning:					
	Site selection	0	staff days	$250	$0	*Pro staff 250/day*
	Training	5	staff days	$250	$1,250	
Field Work/ Mobilization	Vehicle:*	0	site visits	$3	$0	*$0.34/mile*
		(12 x no. of sites)				*10 mi/site*
	Staff time:*	0	site visits	$100	$0	*2 staff/site and 0.20 day/site*
		(12 x no. of sites)				
Laboratory	Analysis:	0	samples	$10	$0	
Data Managemen	Data entry	10	sites	$125	$1,250	*0.5 staff day/site*
Analysis/Report	Analysis:	5	staff days	$250	$1,250	
	Reporting:	5	staff days	$250	$1,250	

Total	**$12,500**
25% contingency	$3,125
Grand Total	**$15,625**

***NOTE:** Vehicle and staff time for field work are included in the cost estimate for water quality monitoring. Hydrology and WQ visits will occur simultaneously. Conducted independently, a vehicle cost of $3/site visit and a staff cost of $100/site visit would be assigned for each hydrology site.

**Does not include cost of discharge curve development

Year One Long-term Monitoring Program Cost Estimate

Program Total: $102,118